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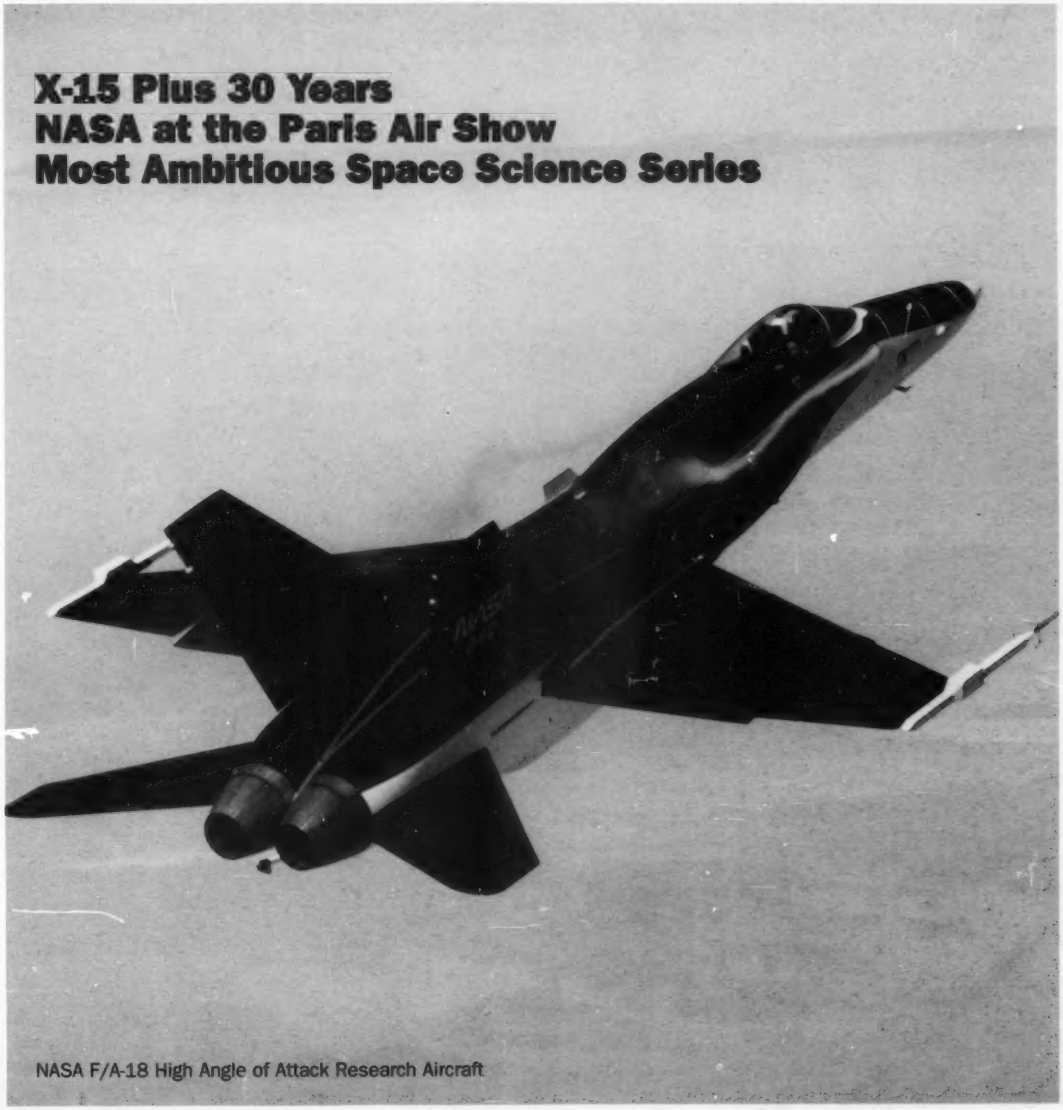
X-15 Plus 30 Years
NASA at the Paris Air Show
Most Ambitious Space Science Series



NASA F/A-18 High Angle of Attack Research Aircraft

THIS ISSUE

With the aim of bringing "coherence, continuity and commitment to the U.S. effort to explore, study and develop space", President Bush has established the National Space Council. Vice President Quayle will chair the Council. Some of the President's remarks are presented on the facing page of this month's *NASA Activities.*

Thirty years ago, a black spaceplane dropped from a **B-52 carrier aircraft** to initiate the world's first hypersonic flight research program. The legendary X-15 made research history from 1959 to 1968 as it explored the aerospace envelope as it never had been plumbed before, providing technology for air and space travel.

A "new golden age of space science" is underway as Magellan crosses space to Venus. The U.S. has stepped out with 36 major space missions slated for the next five years. An outline of this ambitious space science series is featured.

A full-scale cutaway model of the Hubble Space Telescope will be the centerpiece of NASA's display at this year's Paris Air Show. The NASA Visions section provides an advanced peek at the exhibit.

Salutes are due the Goddard Space Flight Center as it celebrates its 30th year of providing leadership in space and Earth sciences. A look at its past and future is provided in this issue.

Next Month:

Apollo 11: The Giant Leap for Mankind.

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About the Cover

The NASA Ames-Dryden F/A-18 High Angle of Attack research aircraft conducts flow visualization studies of the leading edge extension (LEX) vortex breakdown with LEX fences. This photo shows the aircraft plowing 20 degrees nose-high through the air during a 15 to 30 degree sweep maneuver. The vortices can be seen bursting near the fin-like fences. Flying the joint Langley/Ames-Dryden mission is Dryden Chief Pilot William H.Dana.

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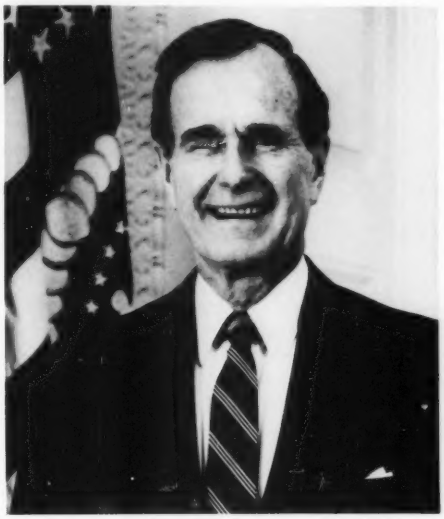
President Establishes National Space Council

Vice President Appointed Chairman

The following are excerpts of remarks by the President made during the signing ceremony for the Space Council Executive Order, held April 20th in the Vice President's Office, Washington, DC.

Addressing the ceremony audience, President Bush said:



"You're helping to fulfill a promise that I made 18 months ago in Huntsville, Alabama — at the George C. Marshall Space Flight Center.

"I pledged then and I'm proud now to reestablish the National Space Council. I've asked Vice President Quayle to serve as chairman. Under his able leadership, I'm confident that the Space Council will bring coherence and continuity and commitment to our efforts to explore, study and develop space. I look to the Council to coordinate our civil, military and commercial efforts. We must establish a permanent manned presence in space by building the Space Station Freedom. We must encourage private initiatives in investment, and we must ensure our national security through effective defense activities in space.

"You know, when people talk about space exploration, what it represents to us, in this country — some say that it captures the American imagination. But it's much more than that. Our efforts in space unleash the imagination.

"And 20 years ago, an entire generation of Americans was inspired by the space program. We must continue on the path we've blazed in earlier decades with a renewed dedication.

"Space is vitally important to our nation's future and, I would add, to the quality of life here on Earth. And it offers a technological frontier, creating jobs for tomorrow. And space programs inspire an interest in math and science, engineering in young people — knowledge so important for a competitive future. Space offers us the chance to unlock secrets billions of years old and billions of light years away. Space is the manifest destination of a new generation and a new century.

"...I plan to sign this Executive Order with one objective in mind — to keep America first in space, and it's only a matter of time before the world salutes the first men and women on their way outward into the solar system. All of us want them to be Americans." ■

"I sign this Executive Order with one objective in mind — to keep America first in space, and it's only a matter of time before the world salutes the first men and women on their way outward into the solar system. All of us want them to be Americans."

X-15 Plus 30 Years

June 8th marked the thirtieth anniversary of the first flight of the X-15 research vehicle. The flight, launched from beneath the wing of a B-52 carrier aircraft and piloted by North American Aviation test pilot A. Scott Crossfield, glided to an unpowered landing on a dry lakebed in California's Mojave Desert. It was the first flight of the first hypervelocity research vehicle.

Conceived as the next step in a series of rocket powered research airplanes, the X-15 was designed for manned hypersonic flight research at speeds up to 4,000 miles per hour and altitudes of 50 miles. It exceeded both goals considerably.

In addition to aerodynamic and aerothermodynamic research, X-15 designers anticipated that the vehicle could explore, for the first time, some of the problems of manned space flight during brief periods at extremely high altitudes. To do this, they included rocket-thrusters (reaction controls) for attitude control in space flight and came up with a combination aircraft-spacecraft.

After contractor demonstration flights, the X-15 made its first research flight on March 25, 1960, with NASA's chief X-15 pilot, Joseph A. Walker, at the controls. Two unofficial world records — 354,200 feet (67+ miles) and 4,520 miles per hour, or 6.7 times the speed of sound would eventually be established by the X-15.

The three X-15 aircraft served as reusable manned platforms for a wide range of experiments that helped advance the development of vital aeronautical and space flight systems. Materials, instrumentation, space suits, and techniques were developed for NASA, as well as for the military.

A. Scott Crossfield piloted the 14 X-15 contractor launch flights, reaching Mach 2.97 and 81,200 feet altitude. Involved in its initial concept and development, he then went to work for NAA's design group for three years before taking the plane to flight test. Crossfield told *NASA Activities* that the X-15 *"...was a quantum step and one of the most productive research airplanes on record... in fact, today we could be using an X-15 to do a lot of things we have no capability of doing...such as a test bed for a scram jet engine... ...Almost all of the basic heat transfer, high speed aerodynamics work we are now relying on... came from the X-15...It set the pace...."*

Total cost of the NASA, USAF, USN, NAA X-15 program, including development of the three aircraft, was about $300 million.

Test pilot Mike Adams would lose his life in the only fatal X-15 crash in 199 flights.

Prophetically, Paul F. Bikle, NASA Flight Research Center director said in 1964, "Future space programs may well include a lifting reentry and a more conventional landing on Earth, in the fashion demonstrated by the X-15."

Over 16 years later, and 13 years after NASA test pilot Bill Dana brought the 199th and last X-15 flight to a landing on Rogers Dry Lake, the Space Shuttle Columbia touched down on the dry lakebed after 54 hours in space. Manned space flight had come full circle. ■

—The X-15 Research Pilots

X-15 research pilot **Milton O. Thompson,** now chief engineer at Ames-Dryden, said, "*It actually was about 20 years later that this technology was used in the design of the Shuttle...the first real user of X-15 technology.*" *In flying the X-15 "the first shock was launch, it felt like I was being fired off the hook... suprisingly, no one had bothered to tell me about that! In the simulator I had been very relaxed, sitting there smoking a cigarette, having a cup of coffee. Now, in the airplane, I was pinned to the back of the headrest...actually uncomfortable. After my first flight , I made the comment that this was the first airplane I was happy to shut the engine off on!*

William H. Dana, now chief pilot at Ames-Dryden, who flew the program's concluding mission recalls, "*My sixth flight was my most memorable. It was a flight to a little over 300,000 feet, literally and figuratively the high point of my career! My elbow hit the release on my check list, releasing 27 pages of cards into the cockpit, floating around for three minutes of weightlessness, between my face and the instrument panel and that certainly was the favorite flight of my career. I looked up to all the pilots because they were all fine men and dedicated scientists. I think Bob Rushworth did more than his fair share of the program...and a lot of the hard work and got very little of the glory...*"

Joseph A. Walker

Robert M. White

Forrest S. Petersen

John B. McKay

Robert A. Rushworth

Neil A. Armstrong

Joe H. Engle

William J. Knight

Michael J. Adams

AGENCY HIGHLIGHTS

U.S. Launches Most Ambitious Space Science Series

America's planetary exploration program, which almost became an "also ran," assumed world leadership with the launch of the Magellan spacecraft to Venus, according to the head of NASA's space science program.

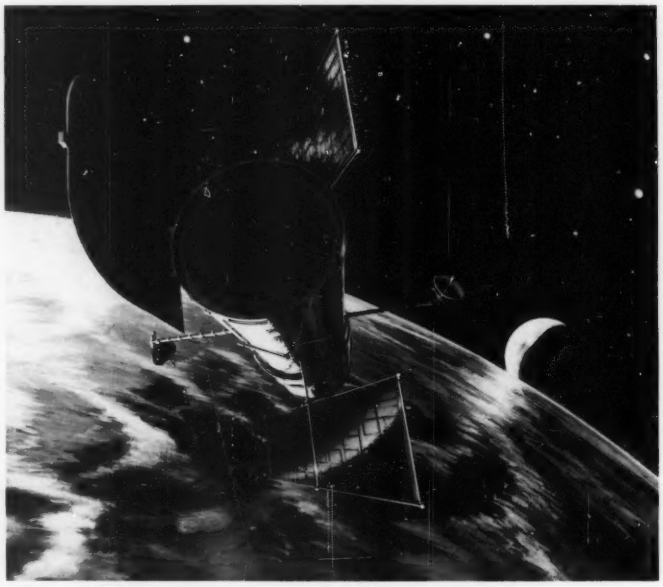
Dr. Lennard A. Fisk said the Magellan launch marks the beginning of a "new golden age of space science" with 36 major missions in the next 5 years. "If we are smart, we will use these missions to conduct the biggest and the most public science and engineering lesson ever for the youth of this nation."

"There is no task more important for a government than to instill in its people the conviction that the future will be brighter than the present," Fisk said. While conceding that there are national defense and poverty problems in this country, Fisk stated that funds have been committed for these activities and that "somewhere among these expenditures that are based on fear and on injustice, there also should be expenditures based on hope for a brighter tomorrow."

Fisk remarked that the United States is again the leader in planetary exploration and "we are determined that never again will this leadership be allowed to pass from us."

Fisk made these and other points:

• Magellan will map the surface of Venus with a radar that has 10 times the resolution of any previous U.S. or Soviet mission.



Artist's conception of Hubble Space Telescope.

Magellan will cover 90 percent of the planet as opposed to only 25 percent by the last Soviet mission and should answer the fundamental question of why Venus — which is so similar to the Earth in size and location — is so different.

• NASA will complete the Hubble Space Telescope, the Gamma Ray Observatory, the Advanced X-Ray Astrophysics Facility and the Space Infrared Astrophysics Facility. These four great observatories, spanning the electromagnetic spectrum from infrared to gamma rays, possess resolution and sensitivity never before possible in astronomy.

• The Cosmic Background Explorer this summer will probe the background radiation left over from the birth of the universe — the big bang.

• The Astro Spacelab mission, next year, will make definitive measurements of the recent supernova — the closest observable supernova in 400 years.

• Ulysses will examine the poles of the sun, the Upper Atmospheric Research Satellite will study the Earth's atmosphere, Mars Observer exploration will follow in 1992 and Galileo will explore Jupiter and its moons in 1996.

• The Earth Observing System (EOS) will study our planet from the polar platforms of Space Station Freedom, making continuous and comprehensive measurements of the Earth and what humans are doing to it. EOS "will serve as a basis for sound policy decisions to protect the future of our planet...a graphic demonstration of American technology in space serving the peoples of the world."

"We need to appreciate," Fisk said, "that with all these activities and plans, we are sending a simple but very powerful message — that we are a nation that believes in its future." ■

Shuttle Mission Assigned Prior to Galileo

NASA has announced that STS-28, but not STS-33, will be flown prior to the Galileo mission (STS-34), currently targeted for Oct. 12, 1989.

This change to the flight schedule has been made to protect the opportunity to launch the Galileo mission early in its launch window and to return the orbiter Columbia to flight status as soon as possible.

STS-28 will be flown around the beginning of August. STS-33, which originally had been planned for August, will be flown after Galileo (STS-34). Launch dates for both missions will be set at their respective flight readiness reviews.

In making the announcement, Richard H. Truly, acting NASA administrator, said: "NASA management has become increasingly concerned that the work involved in preparing the orbiter Columbia for its first flight in over three years is taking long enough that it might endanger the option to launch Galileo at the opening of its launch window. Our overriding objectives in this situation are to protect the Galileo window and to fly Columbia as early as we can. We currently are assessing manifest options downstream of Galileo."■

NASA to Support Commercial Development Sounding Rocket Flights

The National Aeronautics and Space Administration (NASA) has announced support for a series of commercial sounding rocket flights that will provide opportunities for the exploration of industrial space applications by NASA-sponsored Centers for Commercial Development of Space (CCDS).

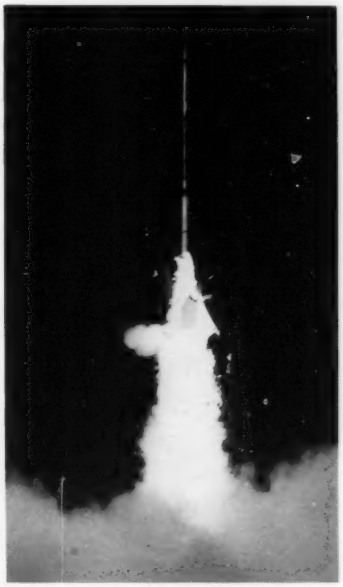
Following the successful flight of Consort 1, a package of materials science investigations launched March 29 atop a commercially-provided rocket at White Sands Missile Range, N.M., NASA's Office of Commercial Programs has decided to extend funding support for a series of similar flights.

NASA will provide funds to help support the costs of payload development and launch services for two additional sounding rocket flights in FY 1990 and is planning to support from two to four flights annually thereafter depending on requirements.

The Consort 1 mission was conceived and managed by the Consortium for Materials Development in Space at the University of Alabama-Huntsville (UAH). The mission represented a pilot project in which $1.4 million in NASA grant monies, provided to the UAH Center for Commercial Development, financed the purchase of commercial launch services and payload integration.

"This experiment in private sector space operations worked marvelously," said James T. Rose, NASA assistant administrator for commercial programs. "The launch was a first for the U.S. commercial space transportation industry, proving that a private provider can efficiently serve the requirements of a commercial user with a minimum of government involvement."

Follow-on, sounding rocket flights will be procured and managed by the UAH CCDS, who also will integrate and prepare for flight the payload investigations conceived and developed by participating CCDS and their industry partners.



Commercial Starfire sounding rocket launches Consort 1 scientific package.

NASA's Office of Commercial Programs, Washington, D.C., created in 1984 to provide a focus for efforts to encourage greater private sector involvement and investment in the nation's civil space program, is responsible for the establishment and management of the 16 CCDS. ■

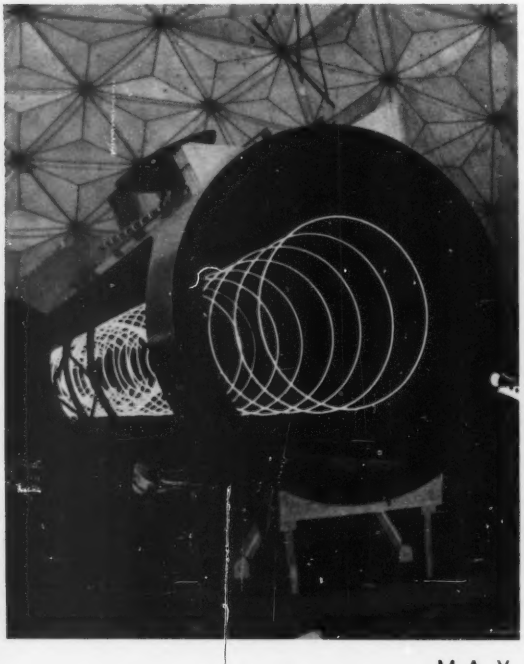
NASA at the Paris Air Show

As a major representative of United States technological and scientific capability, NASA has been a participant at the Paris Air Show at Le Bourget Airport since the mid-sixties.

This biennial event attracts government officials, aerospace institutional, and industry representatives from around the world. More than 200,000 general public visitors typically attend this ten-day show.

In 1973, NASA, in cooperation with the Soviet Union, constructed a separate pavilion with an exhibit marking the Apollo/Soyuz test project and , beginning with its 1979 exhibit NASA has, each year since, developed the 7,000 square-foot public access portion of the U.S. National Pavilion, which then became known as the NASA exhibit.

The 1989 exhibit will focus on the Hubble Space Telescope, which is scheduled for launch next year. The centerpiece of the exhibit will be a full scale mock-up of the space telescope which will be cutaway to show the interior components. Other NASA



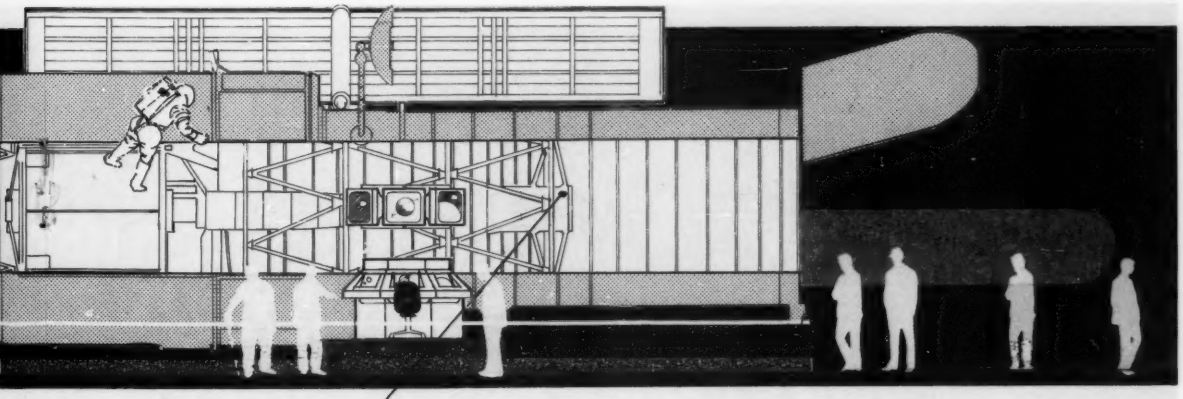
An 80-foot mural, "The Big Bang", (above) depicts the evolution of the universe. The Hubble Space Telescope mock-up cutaway (left) exposes the basic units and structure of the telescope.

programs featured prominently in the pavilion will be exhibits on Space Shuttle and Space Station, both of which play a major role in the deployment and servicing of the Hubble Space Telescope.

Two separate exhibits, one commemorating the twentieth anniversary of Apollo 11's lunar landing on July 21st, 1969, and another on NASA aeronautics, which will feature the National Aero-Space Plane, complete the NASA presentation.

The USA National Pavilion, organized and managed by the U.S. Department of Commerce, is a complete exhibition facility affording American exhibitors an exclusive national presentation for their products and services. ■

The NASA exhibit concludes:
"We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time."
—T.S. Eliot



CENTER HIGHLIGHTS

Goddard Turns 30

Glorious Past, Promising Future

The month of May marks Goddard Space Flight Center's 30th anniversary. During the past three decades Goddard has built and tested more than 40 satellites at its Greenbelt, Md., facility; has managed approximately 160 different satellite projects for NASA, has launched 171 payload-carrying Delta rockets, and has flown more than 2,500 sounding rockets and 550 scientific balloons from all corners of the Earth.

The Center has also proven itself a leader in space and Earth sciences and can boast many NASA "firsts" such as the first weather pictures from space (Tiros 1, launched 3/1/60) and the first and only spacecraft to pass through the tail of a comet (International Cometary Explorer, September 1985).

Goddard's Beginnings

NASA gave birth to its first major scientific laboratory on May 1, 1959. Named the Goddard Space Flight Center in commemoration of Dr. Robert H. Goddard, American pioneer in rocket research, the new facility was dedicated to basic space research and the development of satellites, space probes and vehicles, tracking, communications, and data reduction systems.

The diversity of all these activities made Goddard the only NASA center with significant responsibilities in every area of space exploration, from conceiving satellites to using the data they return.

Goddard Today

Today, Goddard remains NASA's foremost laboratory for space science and services. A modern campus-like complex of 29 buildings on 1,100 acres of rolling Maryland countryside, it employs nearly 12,000. Its budget is more than $1 billion annually. Center officials also manage the Wallops Flight Facility, Wallops Island, Va.; the Goddard Institute for Space Studies, New York, N.Y.; a ground terminal at White Sands, N.M.; and ground stations in Ascension Island; Santiago, Chile; Dakar, Senegal; Guam; Hawaii; Yarragadee, Australia; Merritt Island, Fla.; Ponce de Leon, Fla.; and Bermuda.

Leading the Future

Goddard's contributions to science will extend far into the future.

In Earth sciences, the Upper Atmosphere Research Satellite, which will study atmospheric changes that affect weather and climate, will launch in 1991.

The Goddard-managed NASA Polar Orbiting Platform-1 of the Earth Observing System will be launched in 1996 and will carry up to 20 instruments that will study global changes.

In the near future, Goddard will continue new space science Sun-Earth exploration. Three satellites, GEOTAIL, WIND, and POLAR, part of Goddard's multi-mission International Solar Terrestrial Physics Project, are slated for launch begining in 1992.

Satellites in space allow astronomers to look beyond the thick Earth atmosphere and see the heavens with a clarity unknown before.

Goddard will control telescope operations for NASA's Hubble Space Telescope (HST) manifested to be launched early next year. The size of a railroad box car, this observatory hosts the most powerful telescope ever flown in space.

Goddard is planning several more major space science satellites in the near future: the Cosmic Background Explorer (COBE) and the Gamma Ray Observatory (GRO).

Goddard Center dedication, 1961.

Goddard's communication satellites of today allow NASA to communicate with the orbiting Space Shuttle as well as other low-Earth orbiting spacecraft. A constellation of three Tracking and Data Relay Satellites (TDRSs), now offers communications for up to 90 percent of an orbit as opposed to the 15 to 20 percent coverage afforded by the tracking stations alone.

As Goddard phases down its "workhorse" Delta operations, the Center's involvement in smaller launch vehicles continues to prosper at the Wallops Flight Facility on the eastern shore of Virginia and the National Scientific Balloon Facility, in Palestine, Texas.

The Wallops facility also oversees NASA's balloon program. ■

Wallops Aircraft Supports International Global Ocean Study

A NASA Wallops highly instrumented, remote sensing aircraft is participating in an international oceanographic experiment, called the Global Ocean Flux Study (GOFS), to determine the capacity of the world's oceans to assimilate and store excess carbon dioxide (CO_2) from Earth's atmosphere.

The study results are critical to predicting potential temperature increases in world climate due to the large increase in atmospheric CO_2 caused by the burning of fossil fuels. The increased atmospheric carbon dioxide may lead to a warmer Earth through the greenhouse effect.

The ocean is an important reservoir for CO_2. Some estimates indicate that the ocean has absorbed nearly half of the increased CO_2 produced. Additionally, CO_2 constantly is being exchanged between the ocean and atmosphere. A vital input needed for climatic research is predicting the portion of the CO_2 entering the ocean that will be effectively trapped or removed.

The NASA four-engine, P-3A turboprop aircraft is equipped to measure the concentration of phytoplankton biomass in the upper ocean layer. The primary instrument, the airborne oceanographic lidar (AOL), will use a blue-green laser to stimulate fluorescence from chlorophyll contained in phytoplankton, the microscopic plants at the bottom of the marine food web.

The Global Ocean Flux Study efforts include scientists and research vessels from West Germany, Canada, Great Britain, the Netherlands and the United States. The study is expected to continue over the next 10 years.

The initial experiment involves studies of the spring phytoplankton bloom in the eastern North Atlantic Ocean.

The U.S. research vessel Atlantis II, has placed instrumented moorings at two sites along the 20th west meridian. Atlantis II, along with research vessels from the other participating nations, will study related phytoplankton productivity as the bloom moves northward in response to increasing solar radiation and the development of thermal stratification in the upper ocean.

Study team officials (l to r) Bob Swift, Frank Hoge and Ed Lange inspect phytoplankton distribution estimate map.

The P-3A aircraft participated in the spring bloom study for a 6-week period beginning April 20. Airborne surveys were staged from Lajes, Azores; Shannon, Ireland; and Keflavik, Iceland. ■

Marshall Expands University Research Partnership

NASA's Marshall Space Flight Center (MSFC) is initiating a program to share scientific and engineering data from flight experiments with American colleges and universities.

The universities participating in the program to date include: Auburn University; Northwestern State University of Louisiana; and West Virginia University. These are among the total of six or seven universities that will be chosen for the pilot program.

The pilot program, called the NASA/University Joint Venture Initiative, will make available scientific and engineering data generated from space missions in exchange for analysis and interpretation by faculty members and students.

The universities also will be encouraged to start outreach programs to bring the excitement of the space program into secondary and elementary schools in their area.

"The future of the U.S., particularly our economy, depends on our technology. It's the kids, the ones who are now making career choices about science and engineering who are going to generate the new technology of the future on which we'll depend as a nation," said Dr. Rick Chappell, associate director for science at MSFC.

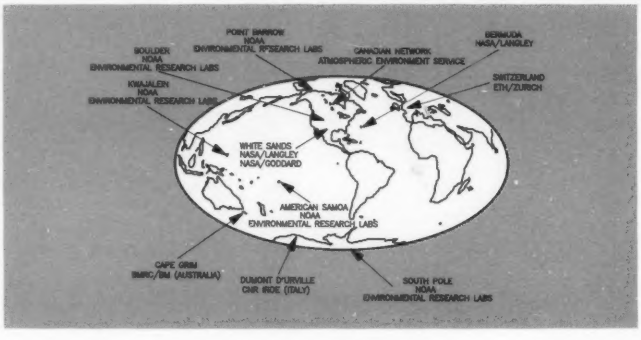
In 1989, the nation's space program is expected to generate several trillion bits of raw science and engineering data, roughly equal to the amount of information stored in the Library of Congress. "...And the amount is going to increase by about a factor of a thousand over the next half a decade," Chappell said. ■

Langley Conducts First Global Surface Radiation Budget Experiment

By Joan Drummond Clough

NASA has conducted the first Global Surface Radiation Budget (SRB) satellite data validation experiment to measure solar and thermal radiation reaching the ocean and land surfaces under all types of clouds.

The purpose of the experiment, which is part of the World Climate Research Program, was to obtain a special set of high-quality data from a number of ground-based verification sites, known as ground truth sites, during April. Each of these sites made local measurements from horizon to horizon.



Since approximately 70 percent of the globe is ocean, it is essential that ground-truth data at several ocean sites be obtained. These measurements are being collected by NASA, the National Oceanic and Atmospheric Administration, U.S. Army, Canadian Atmospheric Environmental Service, and environmental agencies in Italy, Australia and Switzerland.

Langley Research Center has the lead role in NASA's Earth radiation budget program and was responsible for the United States' part of the global SRB experiment. Langley elected to conduct an SRB ground-truth experiment at the NASA tracking station on Bermuda because cloud climatology over the island was expected to be identical to that of the surrounding deep ocean during the month of April.

The experiment involved launching approximately 120 small weather balloons from the U.S. Naval Air Station Annex on Bermuda, locating solar/thermal instrument packages at the Naval Air Station Annex and the NASA tracking station and locating two lidar (light detection and ranging) systems at the NASA tracking station.

Up to four standard Vaisala weather balloons were launched each day to obtain vertical profiles of temperature and humidity. Launch times coincided with overpasses of the NOAA polar orbiter satellite at approximately 2 a.m. and 7 p.m., local standard time.

The Bermuda stations took solar and thermal data every minute in conjunction with the two lidar systems and weather balloons. Bermuda has a dry maritime atmosphere while both Kwajalein Island and American Samoa are wet maritime atmospheres.

Switzerland collected mountain data; the South Pole, Antarctic coast, Alaska and Northern Canada sites collected polar data; White Sands collected desert measurements; Boulder collected high plains data; and other parts of Canada collected variable-latitude data.

Langley has established a Satellite Data Analysis Center (SDAC) as part of the World Climate Research Program. The satellite and ground-truth data received during the global SRB experiment will be synthesized and analyzed by the SDAC and distributed to investigators for regional validation studies. Regional studies will be conducted for each of the surface data sets around the globe. The ultimate goal of the experiment is to publish global maps showing the balance of the surface radiation energy coming from the sun and emitted from the Earth. ■

JPL Proves Mobile Satellite Comm System

A two-way digital voice terminal for land, aeronautical or maritime mobile communications has been demonstrated in the field for the first time by researchers from NASA's Jet Propulsion Laboratory.

The trial, which took place in late March, is believed to be the first-ever field test of a state of the art, low-bit-rate voice coder over an on-orbit satellite in a commercial application.

During the tests, researchers used a voice terminal on a Federal Aviation Agency Boeing 727 to communicate with a ground station in Southbury, Conn. The jet was airborne over the eastern U.S. seaboard during the tests. Signals were relayed between the plane

continued on page 13

Q&A

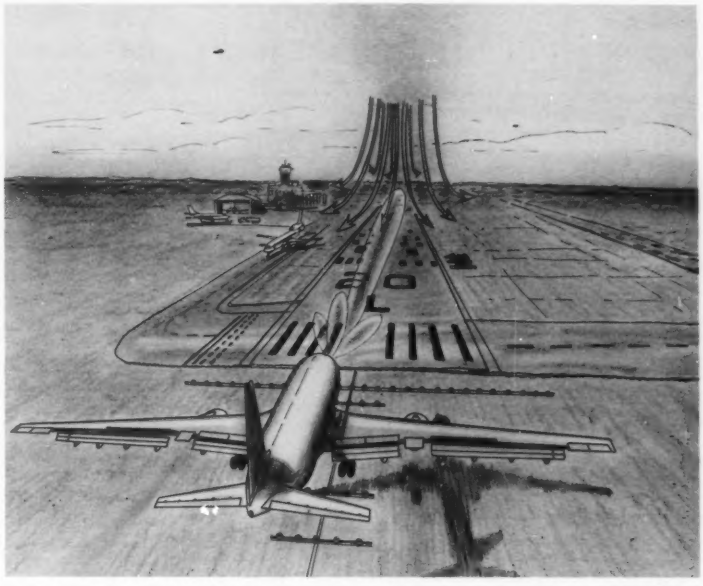
The following questions and answers are excerpted from interviews conducted for NASA's space and aeronautics report, "Frontiers".

DANGER: Wind Shear!

A close encounter with the phenomenon known as "wind shear" during takeoff or landing can spell disaster for even the mightiest airplanes and most experienced pilots. During spring and summer, vicious wind storms called "microbursts" hide beneath harmless-looking cloud decks, or lurk invisibly inside gentle shafts of rain.

Q What is NASA doing to reduce the wind shear risk to aircraft?

A At NASA's Langley Research Center, Hampton, Va., Roland Bowles and colleagues Dave Hinton and Emedio Bracalente are exploring new ways to help pilots detect and survive low altitude wind shear. Says Hinton, "We're learning much more about the structure of the microburst, how they form, how they evolve; the weather that is conducive to the formation of the microburst, and where those winds may occur....We do not yet have the capability of putting a device on an aircraft that will tell a pilot how strong the microburst is going to be before he reaches it. The best we can do today is to put devices on the aircraft and measure the strength of the microburst as he is flying through it, or the part he's already flown through. A major effort within this program is to develop forward looking sensors. They can look ahead of the aircraft, detect a microburst before you enter it so that you may avoid it altogether.



Microburst activity illustrated over a runway as a transport aircraft approaches.

Q What kind of sensors let a pilot see microbursts ahead?

A Doppler radar onboard the aircraft is one sensor that can detect a microburst, as can lidar, a laser detection and ranging device. Doppler radar, which shows a microburst from the water droplets moving within it, is best for the so-called "wet" microbursts while lidar excells in detecting microbursts that are relatively dry. Lidar "sees" particulate matter, dust, insects, etc. but is attenuated or blocked by too much moisture," according to Bracalente. An infrared system that detects microburst temperature differentials is being developed by Turbulence Prediction Systems, Boulder, Colo., under a NASA SBIR contract monitored by Langley, and will be flown this summer on Langley's 737 aircraft. The doppler radar system will be flown as early as next year. ■

Comm System
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and ground by an orbiting satellite operated by the International Maritime Satellite (Inmarsat) organization.

"The system we demonstrated is a type that would be beneficial for planes in transit over the Atlantic Ocean," said Dr. William Rafferty, manager of JPL's Communications Section, which conducts the Mobile Satellite Experiment (MSAT-X) program for NASA.

Planes flying over the Atlantic currently must relay communications at times through other planes on the ocean route. A mobile satellite communication system would link each plane to ground stations via satellite.

Under the MSAT-X program, JPL has been developing technologies that would be useful in mobile satellite systems. ■

NASA NEWS CAPSULES

News Capsules are NASA news releases edited by the Internal Communications Branch, Office of Communications.

NASA Picks Small Explorer Missions

Dr. Lennard A. Fisk, associate administrator for NASA's Office of Space Science and Applications (OSSA), has announced the selection of the first Small Explorer missions, which will study some of the most important questions in space physics, astrophysics and upper atmosphere science.

Termed Small Explorers, these spacecraft weigh approximately 400 lbs. and can be launched from available Scout-class expendable launch vehicles.

The selected studies, chosen from 51 submissions, propose the following:

- The Solar, Anomalous and Magnetospheric Particle Explorer, to be launched in mid-1992.
- The Submillimeter Wave Astronomy Satellite, which would be launched in mid-1993.
- The Fast Auroral Snapshot Explorer, which would be launched in late 1993.
- The Total Ozone Mapping Spectrometer (TOMS).

Costs for developing such spacecraft and instrument payloads are expected to average $30 million. ■

Goddard Selects Flight Telerobotic Servicer Development Contractor

NASA's Goddard Space Flight Center has selected the Martin Marietta Space Systems Co., Denver, Colo., to negotiate a cost-plus-award-fee contract for the flight telerobotic servicer (FTS) for use in the assembly and maintenance of Space Station Freedom.

The contract, expected to be effective on July 1, 1989, will consist of the delivery of flight hardware and software for three missions which consist of two demonstration test flights (DTF) aboard the Space Shuttle and an operational system for Space Station Freedom. In addition, the contract will contain an option for engineering support during the life of the contract.

The total cost, excluding fee, as proposed by Martin Marietta for the basic effort, is approximately $297 million with an additional cost of almost $6 million for the option. ■

Lockheed to Develop Advanced Solid Rocket Motor

NASA has announced selection of Lockheed Missile Systems Division for final negotiations leading to the award of a contract to design, develop, test and evaluate a Space Shuttle advanced solid rocket motor (ASRM) and a contract for construction of facilities for production and testing of the ASRM hardware. The effort also will include an option for production of up to 44 motor sets. The new motor will replace, in the mid-1990s, the current Shuttle redesigned solid rocket motor.

The total cost for the approximately 7-year development project and facility work is estimated by Lockheed to be in excess of $1.1 billion. The precise values of both contracts will be determined in negotiations between NASA and Lockheed.

The ASRM program goal is to enhance Shuttle system reliability, safety and performance. It is also intended to provide the Shuttle with the capability to lift heavier payloads into orbit, with the design goal being an increase of at least 12,000 pounds over the current performance.

The facilities planned for construction are at the Yellow Creek site in extreme northeastern Mississippi, near the city of Iuka, with additional specialized ground test facilities to be constructed at the John C. Stennis Space Center.

The Marshall Space Flight Center has management responsibility for the ASRM and will directly manage performance of the contract. ■

Lewis Awards Contracts For Advanced Power System

The NASA Lewis Research Center, with funding from the Department of Energy (DOE), has awarded parallel contracts to complete the design, fabrication, construction, assembly and test of a 25 kilowatt solar thermal energy advanced power system.

This work, which holds promise for highly efficient, clean, long lifed, and reliable dynamic power, may also have application to NASA's research on future space-power systems. The designs include a free-piston Stirling engine, a liquid metal solar heat transport receiver and a means to provide power to a utility grid.

Lewis Research Center, with substantial background and expertise in Stirling engines, is providing technical management under an interagency agreement with Sandia National Laboratories, which is managing the parabolic-dish, solar thermal concentrator Stirling program. ■

HUMAN FACTORS

Associate Deputy Administrator Hinners Resigns

Dr. Noel W. Hinners, third ranking official of NASA and the principal senior assistant to the administrator and deputy administrator, resigned from the agency, effective May 14, 1989.

"I regret leaving before the transition to the new NASA administration is complete," Hinners said, "but uncertainty in interpretation of new post-employment laws led me to move the date forward. I am heartened, however, by knowing that the incoming administrator and his deputy will provide excellent leadership and advocacy of NASA and its institution."

Hinners also served as the NASA chief scientist and oversaw the institutional management of the agency. As NASA chief scientist, he was the principal adviser to senior management on agency-wide aspects of NASA's scientific activities.

Before his appointment to senior headquarters management in June 1987, Hinners served 5 years as director of the Goddard Space Flight Center. From 1979 to 1982, he was director of the Smithsonian Institution's National Air and Space Museum, and from 1974 to 1979 he served as NASA associate administrator for space science. Hinners joined NASA in 1972 as deputy director of lunar programs, Office of Space Science, NASA Headquarters. ■

McBride Leaves NASA: Brand Named STS-35 Commander

Astronaut Jon A. McBride (Captain, USN) departed NASA May 12, 1989. McBride was named last year to command the STS-35 (ASTRO-1) mission. He is succeeded as STS-35 commander by Vance D. Brand.

McBride was selected as an astronaut in August 1978. He flew in space as pilot aboard Challenger on STS 41-G in October 1984 and was scheduled to fly in March 1986 as the commander of STS 61-E, deferred by the Challenger accident.

McBride recently completed an assignment at NASA Headquarters as the assistant administrator for congressional relations, a post he held since September 1987. ■

Odom Retires, Moser departs NASA

James B. Odom

Thomas L. Moser

James B. Odom, associate administrator for the Space Station Freedom program, has retired from NASA.

"After 33 years, I've decided to make a career change," Odom said. "I regret the timing of my decision, but the impact of some upcoming changes on government retirees made it such that I did not get to pick the most desirable or optimum time to retire."

Odom was appointed associate administrator for the space station program in April 1988. He came to Washington, D.C., from the Marshall Space Flight Center, where he had served in a number of key positions over the past 30 years.

Among the positions he held at Marshall were director of the Science and Engineering Directorate, manager of the Space Telescope Project and manager of the External Tank Project.

Thomas L. Moser, acting associate administrator for the Space Station Freedom program, left NASA effective May 13. Moser, who was appointed deputy associate administrator for the Freedom program last December, has been serving as the acting associate administrator since April 30.

"My decision to leave is in no way a reflection on the status of the program," Moser said. "I am convinced that the Space Station Freedom program is absolutely necessary for this country to maintain its leadership in space and that NASA, along with the contractor team and international partners, will make it a success given the proper support. I'll sincerely miss NASA, but after 26 truly fulfilling years, I feel that it's the right time to go."

Moser served as the first program director of the Freedom program, a position he held from October 1986 to December 1988. He oversaw the establishment of the Space Station Freedom Program Office located in Reston, Va., and guided the program through extensive reviews.

Moser also helped put in place the structure for international cooperation in the Freedom program, which was formally adopted by the United States and the 11 participating countries last year.

From February 1986 until he was named to the space station post, Moser was deputy associate administrator for space flight at NASA Headquarters. Prior to that, he was director of engineering at Johnson Space Center, Houston.

Moser began his career with NASA in 1963. ■

ANOTHER DIVIDEND FROM AIR & SPACE

Astronaut Cool Suit Helps HED Kids

Suits designed to keep astronauts cool are now giving new freedom to youngsters whose bodies lack a cooling system of their own. H. Keith Henry, Langley public affairs specialist, presented a "cooling suit" to an Indian child on a recent trip to the Near East.

Four-year-old Tanu Arora suffers from Hypohidrotic ectodermal dysplasia (HED); he was born without sweat glands. Without perspiration to cool him, Tanu risks heat exhaustion in hot weather or during any type of vigorous activity. When ill, a fever could be fatal. The child's father, who had heard about the space-age suit, called NASA and was in turn, put into contact with the HED Foundation.

Henry was in India to attend the International Astrophysical Federation conference in Bangalore. A HED Foundation board member, Henry made arrangements to travel to New Delhi, meet the Arora family and make the presentation before returning to Langley.

"The suit originated in a NASA program that produced a channeled cooling suit for astronauts", Henry said. "The key to the garment is a cooling hat and vest, which absorb heat from the torso and head, where most body heat is given off." The system is designed to eliminate 40-60 percent of a person's stored body head while lowering the heart rate by 50-80 beats per minute.

The HED Foundation was established last year in Hampton, Va., by Sara Moody who was successful in obtaining such a suit for her nephew, after calling John Samos and Thayer Sheets of Langley's Technology Utilization Office. Henry said the HED Foundation's work is a good example of how space technology can be applied on earth to help people live happier, healthier lives.

The suit, manufactured by Life Support Systems, Inc., Mountain View, Calif., was the fifth to be presented by the Foundation.

H. Keith Henry, (right) exhibits the "cooling suit" to the Arora family, including four-year-old Tanu.

"The invention of the cooling suit has boosted our morale," said Tanu's father. "We are confident that Tanu's life will now be more normal." ■

BACK FROM SPACE: STS-29 mission specialist Jim Bagian receives a welcome home greeting from his youngest daughter, Kimberly.